A new methodology for the treatment of Monte-Carlo vs. Experimental data

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This work will be performed as part of a doctoral thesis. Its objective is the development of a methodology based on gamma ray densitometry techniques and artificial neural networks to predict volume fractions in multiphase flows with the support of computational fluid-dynamics (CFD) and MCNP-X code [1].

The Monte-Carlo technique is widely used within the radiation field, in medical and industrial researches, radiation protection and nuclear facilities, for examples. It is an excellent tool for radiation transport that helps project development since it facilitates the construction of geometries, use of varied detectors and energies, thus eliminating problems with detector availability, radiation sources, and experimental tests, since there is no need of an experimental arrangement.

However, a wrong modeling can bring problems to the project, increasing unforeseen costs, among other problems, such as the time lost in its development. On the other hand, a proper modeling, which ensures the complete matching up of computational with experimental results, is extremely important.

The methodology is simple and can be applied in several studies, particularly those that focus volume fraction determination in pipelines.

Such methodology was developed because of the great difficulty found to validate the modeling of a 3x3" NaI(Tl) detector, because the simulated results were very different from the experimental results. Initially, the modeling was performed in MCNP-X code, but, as the results were very different, we decided to use Gate code for that modeling. The latter results also diverged from experimental and from those obtained by MCNP-X code.

In face of those difficulties, we perceived the need for a new methodology meeting the following criteria:

- Simple to implement;
- That could be implemented in both codes in the same manner;
- And that brought the same results in both codes.

The new methodology consists in the normalization of the results obtained by MCNP-X and Gate codes followed by a denormalization by a standard value, which will be the same in all denormalizations for the same source.

Initially, the spectra obtained by simulation are normalized using the highest value of the photopeak, which we will call CPSs. We used the photopeak region because it is the region of interest. The experimental spectrum is then normalized, also by the photopeak's highest value, which we will call CPSe. To denormalize the simulated spectrum it is only necessary to multiply it by CPSe.

By using CPSe to denormalize we ensure that the region of interest of the simulated spectrum is as close as possible to the experimental, thus validating the simulated model, as shown in Figure 1.

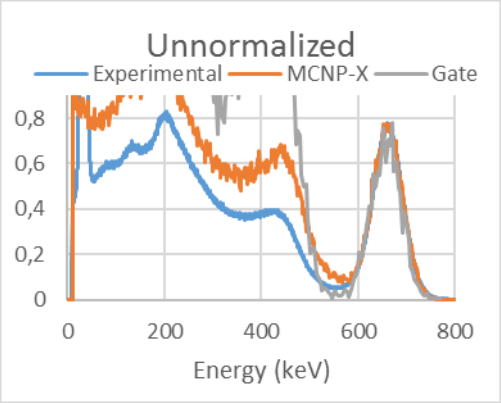

Figure 1. Cs-137 spectra

References

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